

Tilburg University

Economic Development in Europe

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Publication date:
1998

[Link to publication in Tilburg University Research Portal](#)

Citation for published version (APA):

van de Klundert, T. C. M. J. (1998). *Economic Development in Europe: 1960-1996*. (FEW Research Memorandum; Vol. 761). Macroeconomics.

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Economic development in Europe: 1960 - 1996

by

Theo van de Klundert*

Il n'y a pas, si l'on y songe, de sociétés développées, il n'y a que des sociétés en développement - de mêmes que les sociétés dites par euphémisme <<en voie de développement>> ne sont que des sociétés non développées. Il faut rabattre d'un cran les prétentions, pour mieux soutenir les ambitions.

Alain Peyrefitte, *La société de confiance*, p. 413.

1. Introduction

Looking back at the economic development and growth in Europe after World War II one sees a diversified picture. Peyrefitte is right, it is not a simple matter of growth at a lower or higher rate. Fundamental changes of structure and behaviour occur and leave their impression on the economic landscape. Description and theory must be combined to get a grip on economic history. An eclectic approach is called for, which opens the possibility to apply different theories in an appropriate setting. This holds true also for shorter time periods like the one we are considering in this contribution. Such a broad perspective on growth and development corresponds to the view of Arnold Heertje expressed at several occasions. In Heertje (1977) the impact of technological change on society is discussed in a way that has inspired us to look behind the accepted methods of economic analysis.

The period of reconstruction immediately after the war is not discussed here. Instead we start our investigations around 1960 with the process of convergence to the productivity level in the US in full swing. Convergence or catching-up dominated the development till around 1973. In the decade following the first oil crisis Europe had to deal with exceptional high rates of inflation. It is usually thought that the lower growth rate in the period 1973-1983 resulted from deflationary policies that were necessary to curb inflation. This may be true to a certain extent, but we think that structural adjustments on the supply side of the economy have played an important role in the background. The traverse to a lower rate of growth as appears from Figure 1 is characterised by radical change in the allocation of factors of production. The

* I am indebted to Richard Nahuis, Ton van Schaik and Sjak Smulders for useful comments. Remaining errors are of course mine.

exhaustion of the catching-up potential makes the European economy more vulnerable. Innovation has to dominate diffusion as the economy must stand on its own legs. International competition becomes more intensive, but at the same time there may arise new possibilities for the international division of labour.

The article is organized as follows. In Section 2 we discuss the period of catching up, 1960-1972. Following the literature on this point we discuss the causes that may be responsi-

Insert Figure 1

ble for the relative high rates of economic growth over this period. The period of structural adjustment, 1973-1983, is the topic of Section 3. Applying a three-sector growth model of Lowe (1976) we show the change in composition of sectors that goes along with a decline in the long-run rate of growth. The traverse from one steady state to another may cause serious problems of adjustment leading to excess supply of production factors with a deflationary impact on the economy. Testing of this theory is not an easy task. Moreover, macroeconomic policies to fight inflation induced a deflationary climate of their own. Nevertheless we think that structural adjustments of the kind analysed in Section 3 have played an important role in the development of the European economy after 1973. The final period under consideration, 1983-1996, is discussed in Section 4. Innovation, competition and the international division of labour are the main topics dealt with. Using statistical material compiled by Dollar and Wolff (1993) changes in the patterns of international specialization are tracked down in sub-section 4.1. Instead of specializing in certain fields firms may try to adopt new technologies introduced by (foreign) competitors. In sub-section 4.2 we develop a model to show what problems may arise in keeping up with competitors. In contrast with standard models of economic growth we show that in a world with imperfect information managerial response to the challenges of the market is an important factor in economic development. The article closes with conclusions.

2. Catching up, 1950 - 1973.

Growth rates in Europe were high in the period 1960-1973 compared with earlier periods but also in comparison with economic growth since 1973, as appears from Figure 1 and Table 1. Many commentators see this period as exceptional and Maddison speaks of “a golden age of unparalleled prosperity” (Maddison 1995). The explanation for this exceptional development can be summarized in two points. First, after the second world war there was a large backlog in terms of capital per capita and output per capita if one confronts the European economies with the situation in the USA. Second, as a result of the war there was a stream of information and knowledge flowing from the US to Europe.

As observed by Abramovitz (1986) and many others the preconditions for a rapid catch up were fulfilled. By 1950 the physical infrastructure was restored, human capital was still

there and people were eager to work, to save and to invest. In retrospect it seems fair to say that the characterisation “société de confiance” (society of trust) applies to this period.

From the vantage point of people living in that era it seemed that the sky was the limit. But economists familiar with neoclassical growth theory introduced in the fifties by Solow (1956) and Swan (1956) should perhaps have known better. Neoclassical growth theory came up in reaction to the more rigid growth theories of Harrod and Domar, which implied that growth with full employment of labour and capital is a knife-edge solution. The neoclassical answer put the production function with unlimited substitution possibilities in the centre of the theory. In case capital grew faster than labour more capital-intensive methods would be applied. Economic growth would slow down, but capital and labour could be fully used. By concentrating on substitution technological change was set in the background and considered to be exogenous. Moreover, knowledge was conceived as a public good, so that technological change should be equal in all countries.

Table 1. *Economic growth, 1950 - 1992*
(annual average compound growth rates)

	USA	France	Germany	Netherlands	UK
	Gross domestic product				
1950-73	3.92	5.02	5.99	4.74	2.96
1973-92	2.39	2.26	2.30	2.14	1.59
	Total hours worked				
1950-73	1.15	.01	.00	-.04	-.15
1973-92	1.27	-.46	-.38	-.07	-.57
	Non-residential capital stock				
1950-73	3.27	4.80	5.93	4.55	5.17
1973-92	3.13	4.30	3.37	3.07	3.32
	Total factor productivity				
1950-73	1.72	3.22	4.05	2.71	1.48
1973-92	.18	.73	1.54	.77	.69

Source: Maddison (1995).

This raises the fascinating question whether countries have their own technology base or can simply draw on an available body of international knowledge. Before going into this question we shall first explore the further implications of the neoclassical growth theory. In the early sixties it was fashionable to perform the art of “growth accounting”. By differentiating

the log-linear production function with respect to time one could impute the realized rate of growth to the proximate causes: capital accumulation, growth of working hours and technological change as a residual. Maddison, who has always been in favour of this method, gives an interesting application of it as shown in Table 1. Growth accounting can be applied to compare the periods 1950-1973 and 1973-1992 in order to put the “golden age” in historical perspective. There are at least three interesting conclusions that can be drawn by looking at these figures. First, total hours worked changed not very much outside the USA during the first period. Second, capital accumulation was very substantial compared with the USA and the later period. Third, the most important factor behind the growth rates in the period 1950-1973 is the change in total factor productivity (TFP). Madisson (1995) measures changes in TFP by relating changes in GDP to the combined input of quality adjusted labour, non-residential physical capital and land. Looking at Germany we see that TFP explains 68% of the growth of output over the period 1950-1973, whereas the corresponding figure for the period 1973-1992 amounts to 67%. It is remarkable that the contribution of TFP-growth to total growth declines substantially in the other countries during the second period. For the USA the relative score of TFP-growth amounts to only 8% in the later period.

The increase in TFP can be conceived as a measure of technological change, which is exogenous in the neoclassical growth theory. There is, however, a long tradition in growth accounting going back to Denison (1962), which aims at explaining the residual as far as possible. This second layer of growth accounting has a weak theoretical base and is confronted with severe measurement problems. For these reasons we here omit these extensions of growth accounting. Following the neoclassical framework the decline in growth rates should be explained by a slower rate of capital accumulation as countries converge to the steady state. Catching up with respect to the capital intensity of the economy is however only a part of the explanation of the growth slowdown in the course of time. As appears from Table 1 there is a substantial fall in the rate of technological change which has to be considered as an exogenous component in the explanation of the decline in economic growth.

In neoclassical growth theory convergence can be modelled in a more direct way. Mankiw, Romer and Weil (1992) approximate the speed of convergence by the formula

$$\frac{d \ln y(t)}{d t} = \lambda (\ln y^* - \ln y(t)) \quad (1)$$

Here y is output per unit of labour expressed in efficiency units and y^* is the steady state level of this variable. The linear differential equation in y can be solved easily. After substituting for y^* one obtains after some rearrangements

$$\ln y(t) - \ln y(0) = (1 - e^{-\lambda t}) \left[\frac{\alpha}{1 - \alpha} \ln s + \frac{\alpha}{1 - \alpha} \ln (n + g + \delta) - \ln y(0) \right] \quad (2)$$

The new symbols are defined as: α = production elasticity of capital, s = savings rate, n =

population growth, g = rate of technological progress, δ = rate of capital depreciation. Equation (2) is estimated by Mankiw et al. for a cross-section of countries over the period 1960-1985. It is assumed that g and δ are constant and uniform across countries. The independent variables in the regression analysis are therefore s , n and $y(0)$. Omitting the constant term the result for the sample of 22 OECD countries reads

$$\ln y(85) - \ln y(60) = 0.392 \ln s - 0.753 \ln (n + g + \delta) - 0.351 \ln y(60) \quad (3)$$

(0.176) (0.341) (0.066)

Standard errors are given in parenthesis. $(g + \delta)$ is assumed to be 0.05. The implied λ amounts to 1.73% and the correlation coefficient is $\bar{R}^2 = 0.62$. From a statistical point of view these outcomes are reasonable. Mankiw et al. (1992) add a measure of human capital to the equation, but for the OECD this only marginally improves the results.

Growth regressions of this type are popular since the beginning of the nineties, despite severe objections that can be made. First, from a statistical point of view the results may be misleading, because regression towards the mean may be the dominant feature. As discussed by Friedman (1992) this point relates to a well documented fallacy in statistical inference. Second, the assumption of a constant rate of technological change over the entire postwar period is at odds with the outcomes of growth accounting presented above. Third, observations indicate that the period 1950-1973 was exceptional in many respects. Boltho (1982) and Eichengreen (1994) discuss the specific institutional arrangements which characterise this period. Van de Klundert en Van Schaik (1996) pooling cross section and time series data show that catching up in Europe is relevant before 1973 but not thereafter.

To understand what made the period from 1950 to 1973 so unique one has to look beyond the macroeconomic figures. Catching up meant the imitation of American efficiency levels and American mass production. Markets for consumers durables and other luxuries developed rapidly. On the supply side growth was not a matter of knowledge spillovers from the US, but was driven primarily by investment in physical and human capital. Knowledge was not the bottleneck but capital in a broad sense was. Following Lamfalussy (1961) one could say that “enterprise investment” in contrast with “defensive investment” dominated the scene. According to Maddison (1995) technological change was to a large extent embodied in capital goods. Moreover, the change towards mass production made it possible to reap economies of scale. The role of capital accumulation was therefore much more important than appears from growth accounting studies like the one presented in Table 1.

The importance of mechanisation and increasing scale especially in the sixties can be documented in many other ways. The share in industrial employment of large firms increased substantial. The degree of concentration in manufacturing increased under impact of mergers and take-overs. It goes without saying that the rapid change of the economy also required substantial organizational and managerial adjustments.

It should be observed that the catching-up process did not extend to the institutional field. As documented by North (1990) institutions change slowly. There are important differences between Europe and the United States which limit in the end the potential for catching up. It is not possible here to go into much detail but mention should be made of the role of nation states with different languages and culture, the role of labour unions, and differences in tax systems implying for instance higher energy prices in Europe. This may explain that the potential for catching up around 1973 was more or less exhausted despite the difference in GDP per worker still existing in that year. If this is true, things had to be changed radically. But it is not easy to understand what is happening in society at large. Firms had to learn it the hard way, which brings us to a discussion of the next epoch.

3. *Structural adjustment, 1973 - 1983.*

According to Maddison (1995) the period 1973-1994 has been an era of chequered performance in which the European economies operated below potential. In the early seventies there were signs of overheating and inflation accelerated (see Figure 2). The breakdown of the Bretton Woods system of fixed exchange rates in 1971 and the oil price shocks in 1973 and 1979 worsened the situation. To curb inflation the authorities had to impose deflationary policies. Effective demand slowed down, resulting in unemployment and higher capital output ratios. There was a sharp reduction in the rate of growth throughout the world in the seventies and the momentum of the golden age never regained in Europe.

Insert *Figure 2*

Maddison sees an important role for demand in explaining the lower growth performance over the entire period after 1973. In our opinion demand played a major role in the period 1973-1983. Firms suddenly realised that a fundamental reorientation was in order. Instead of focussing on efficiency improvements it became necessary to invest in product quality. Moreover, increased competition from Japanese firms required fundamental changes in production. Just-in-time production and higher throughput became necessary to cope with the new situation. The shock therapy of the seventies accelerated the required adjustments. But in turn the restructuring of the economy aggregated the deflationary development by inducing liquidation of capital and sometimes also bankruptcies.

What is at stake can be illustrated using a three-sector model by Lowe (1965, 1976), emphasizing the complexities of roundabout production. Because of this the model has an Austrian flavour, but it also relates to a long tradition in economics in the form of the construction of models with fixed coefficients (e.g. Sraffa, Hicks, Morishima). In Lowe's model there are two sectors producing capital goods with the third sector producing a final good for consumption. Sector Ia produces primary capital goods (like for instance steel) which are

necessary in the production of capital goods (like for instance looms) and which are also used in the production of this primary capital good itself. The secondary capital goods which are produced in sector Ib are applied in the production of the consumption good (say textiles). The consumption goods sector is numbered as sector II. Labour is used in all production processes and the input-output coefficients are fixed.

In the notation introduced by Nell in a mathematical appendix to Lowe (1976) the steady-state model can be formulated as:¹

Quantities

Values

$$\begin{array}{ll} (1 + g) (a_a q_a + a_b q_b) = q_a & (1 + \rho) a_a p_a + (1 + \theta) n_a p_z = p_a \\ (1 + g) b_z q_z = q_b & (1 + \rho) a_b p_a + (1 + \theta) n_b p_z = p_b \\ (1 + \xi) (n_a q_a + n_b q_b + n_z q_z) = q_z & (1 + \rho) b_z p_b + (1 + \theta) n_z p_z = p_z \end{array}$$

The symbols have the following meaning: q = volume of output, p = output price, a = input coefficient of primary capital, b = input coefficient of secondary capital, n = coefficient of labour (expressed in terms of the consumption good), g = growth rate on flow input, ξ = rate of consumption surplus, ρ = rate of profit on current flow input, and θ = net wage rate (“rate of surplus value”). Sector variables are denoted by the appropriate subscript. The subscripts a, b and z relate to sector Ia, Ib and II respectively. The system implies $\rho = g$ when $\theta = \xi$ and the other way around.

To simplify the analysis Lowe (1976) assumes that the capital-output ratios are the same in all three sectors, which implies that the capital-labour and labour-output ratios are identical in a steady state. It should be observed that in order to be comparable these ratios must be expressed in value terms. On the basis of these simplifications Lowe (1976) presents numerical examples for the structure of the economy assuming different rates of growth of labour supply as shown in Table 2. The value of sales (S) in each sector equals the sum of capital depreciation (D), wages (W) and profit (P). The consumption good is chosen as the numéraire of the system ($p_z = 1$). Because input shares are proportional as can be checked easily all output prices can be set at unity. Therefore, values and volumes are interchangeable. The rate of capital depreciation is 10% in each sector. The volume of capital is denoted by K and the rate of profit is denoted by r .

In panel A of Table 2 the steady state growth rate amounts 6% at $t = \tau^2$. The capital-output ratios are equal to 2 and the uniform depreciation rate is set at $d = 0.1$. Output of primary capital goods is 25.6 which is used for depreciation in both sectors ($5.1 + 10.9 = 16$)

¹ The analysis by Lowe is cast in unusual terms. The mathematical appendix by Edward Nell presents the mathematics in a more common form.

² The growth rate in Table 2 is the true growth rate on fixed capital γ . The conversion necessary to obtain g is: $\gamma = d \cdot g$. In a similar way we have $r = d \cdot \rho$.

and for expansion of the stock of primary capital ($0.06 \times 160 = 9.6$). In a similar way output of secondary capital goods amounting to 54.4 is necessary for replacement (34.0) and net investment ($0.06 \times 340 = 20.4$). Output of the consumption goods sector equals the total wage bill. Panel B in Table 2 shows the new steady state structure after a fall in the exogenous rate of labour supply from 6% to 4%. The shock to the system is given in period $t = \tau + 1$. In this period the system readjusts and the new steady state is supposed to apply in $t = \tau + 2$. A traverse from one steady state to another in one period is of course a crude simplification, but the model does not contain formal equations for dynamic behaviour. Instead Lowe discusses changes in prices and expectations that are required to attain a new steady state. However, one

Table 2. *Composition of the economy at different steady states*

A. Economic structure at $t = \tau$ with $g = 6\%$									
	D	+	W	+	P	=	S	K	r
Sector Ia	5.1	+	17.4	+	3.1	=	25.6	51.2	} 6%
Sector Ib	10.9	+	37.0	+	6.6	=	54.4	108.8	
Sector II	34.0	+	115.6	+	20.4	=	170.0	340.0	
Total	50.0	+	170.0	+	30.0	=	250.0	500.0	
B. Economic structure at $t = \tau + 2$ with $g = 4\%$									
	D	+	W	+	P	=	S	K	r
Sector Ia	4.2	+	15.3	+	1.7	=	21.2	42.4	} 4%
Sector Ib	10.9	+	39.2	+	4.4	=	54.5	109.0	
Sector II	38.9	+	140.2	+	15.6	=	194.0	389.4	
Total	54.0	+	194.7	+	21.7	=	270.4	540.8	

Source: Lowe (1976).

can get an impression of the problems involved by comparing the long-run equilibria in Table 2. A decline in the rate of growth implies that more production factors are available for sector II. The production of consumer goods is stimulated at the expense of the production of capital goods. However, to produce more consumption goods additional secondary capital is needed. This in turn is favourable for sector Ia, but that does not solve the problem for this sector. Primary capital goods are in excess supply. It should be noted that the stock of primary capital goods at $t = \tau + 2$ is even smaller then that at $t = \tau$, despite the ongoing economic growth. The stock at $t = \tau + 2$ equals 42.4 and the corresponding output of primary capital equipment is 21.2. This amount consists of replacement ($4.2 + 10.9 = 15.1$) and net investment ($0.04 \times 151.4 = 6.1$). The necessary elimination of capital waste may cause serious difficulties in a

market economy. Losses could induce destabilizing expectations diverting the system from the adjustment path into a recession, even if prices are flexible. The usefulness of the three-sector model in analysing the traverse in case of a change in growth rates is summarized by Nell (1967, p. 292) in the following manner: “During such traverses inputs and outputs in the two subsectors of sector I move inversely: Sector Ia expands while sector Ib contracts and conversely. Not only can such countermovements not be recognized if fixed-capital production is aggregated into one sector, but the ensuing sectoral redundancies or shortages of capacity and labor supply must go unnoticed.”

Dynamic rearrangements of the kind described by Lowe may have played an important role in Europe after 1973. Note that there was a decline in the growth of effective labour supply, but another exogenous component of growth, a lower potential for catching up, may have given rise to similar structural adjustments. Characteristic for a traverse to a lower rate of economic growth is an abnormally high scrapping rate of capital.

It is difficult to measure such an exceptional waste of capital on a macroeconomic level. However, there is indirect evidence for abnormal capital depreciation over the period 1973-1983. Scott (1989) discusses several indications which point towards mistaken new investments and abnormal scrapping of past investments. Liabilities of bankrupt enterprises as a percentage of output in non-residential business increased substantial in the UK if one compares the period before 1973 with that afterwards. Scott notices in this respect that: “big firms do not often go bankrupt, so that *their* scrapping would not show up in these figures, but they were subject to the same pressures as small firms” (Scott, 1989, p. 508). Another indication of abnormal scrapping is found in Wadhvani and Wall (1986) who use company accounts to calculate the rate of growth of the capital stock in UK manufacturing over the period 1947-1982. According to their estimates the total gross capital stock of 333 companies grew 1.45% per annum more slowly than the official estimates. Scott argues that this figure corresponds to abnormal scrapping of a fifth of gross investment in the period under consideration. Summing up, Scott assumes that this share may well apply to the total of gross investment in the period 1973-1985.

In our view the economic turmoil in the seventies and early eighties cannot be explained fully by demand shocks and cyclical adjustment. From a structural perspective the European economies entered a new epoch with a lower potential for growth, more in line with developments over the very long run (cf. van de Klundert and van Schaik, 1996). Moreover, as international diffusion of knowledge played a lesser role the need for innovation increased. After the dust had settled economic growth had to come from shifting technological frontiers much more than it had to in the past.

4. *Competition through innovation, 1983 - 1996.*

New technologies are an important aspect of the increased flexibility of firms in the eighties. The introduction of computers, just-in-time production and rising R&D expenditure are indications of a changing climate. Case studies and descriptions show in detail what is happening (see for instance, Bolwijn and Kumpe, 1994). Innovation is not just a matter of introducing new technologies. Technological change must be complemented by organizational adjustments and new marketing perspectives. Moreover, on many occasions mergers were considered necessary to strengthen the competitive position of firms.

International trade flourishes and competition becomes more global. To a large extent trade between industrialised countries is intrasectoral trade. In this case firms have a special position in the market based on brand names, reputation and public exposure. Incremental improvements of existing operations lead to growth without fundamental change in technology, defined in a broad sense. However, global competitors may induce fundamentally new technologies, which cannot be adopted without incurring substantial costs of adjustment. The question is then, will the firm be able to make the switch before the window of opportunity closes? This fascinating question will be analysed in sub-section 4.2.

A part of international trade reflects the international division of labour and can be characterized as interindustry trade. But is there still room for international specialization among industrialized countries in a world where they are all close to the technology frontier? If so, what are the driving forces behind such an international division of labour? These questions will be dealt with in sub-section 4.1.

4.1 *International specialization of production*

In an interesting study of sectoral developments across industrialised countries Dollar and Wolff (1993, p. 177) conclude: "We found that between the early 1960s and the early 1970s productivity catch-up on the industry level played the dominant role. Indeed, after the early 1970s convergence of labor productivity within industries slowed down considerably (and that of TFP essentially halted). After 1973, convergence continued to occur at the aggregate level, though at a modest pace, while at the industry level there was clear evidence of specialization, with different countries emerging as productivity leaders in different industries." Catching up after 1973 has been restricted to the sheltered sector of the economy (cf. Bernard and Jones, 1996). What has happened in manufacturing is shown in Table 3, where average TFP figures for 13 industrialised economies are compared with TFP results for the US.³ The last column gives the technological leader in each of the sectors. The data source is the OECD International Sectoral Database (ISDB).

As appears from Table 3 Japan and Germany are taking the lead in a number of sectors classified as Heavy Industries at the end of the period under consideration. The relative posi-

³ The other countries are: Australia, Belgium, Canada, Denmark, Finland, France, Federal Republic of Germany, Italy, Japan, the Netherlands, Norway, the United Kingdom and Sweden.

on of the US improves in most of the medium and light industries between 1979 and 1985. Such a non-uniform relative change in productivities may lead to a corresponding change in the international division of labour, because a favourable development of TFP may improve the competitive position of firms in that sector.

Change in trade patterns can be examined by using Balassa's revealed comparative advantage (RCA) indicator (cf. Balassa, 1965). Denoting countries by the index j and sectors by the index i the RCA-indicator for country j and sector i is:

$$RCA_{ji} = \frac{X_{ij} / \sum_j X_{ij}}{\sum_i X_{ij} / \sum_i \sum_j X_{ij}}$$

, where X stands for the volume of exports.

Table 3. *Indices of total factor productivity (TFP) by sector*

	Average TFP/TFP US			Leader
Year	1970	1979	1985	
Sector				
<i>Heavy industries</i>	.71	.77	.87	Japan
Basic metals	.73	.83	1.05	Japan
Chemicals	.69	.76	.93	Germany
Nonmetallic minerals	.70	.71	.64	US
<i>Medium industries</i>	.73	.73	.71	US
Machinery and equipment	.65	.67	.63	US
Paper, printing, publishing	.71	.72	.74	Italy
Food, beverages, tobacco	.83	.81	.75	Italy
<i>Light industries</i>	.88	.78	.72	US
Textiles	.88	.77	.71	US
Wood and wood products	.87	.78	.73	Italy
Other industries	.47	.65	.63	US
<i>All manufacturing</i>	.75	.74	.73	US

Source: Dollar and Wolff (1993).

The numerator shows the share of country j in the total exports by all countries of the products of sector i . The denominator equals the share of total exports of the products of country j in all

exports. The RCA for a country can be greater or less than unity. The index indicates in which sector the country's exports are concentrated and is therefore a measure of revealed comparative advantage.

Countries should develop patterns of specialization in accordance with divergent changes in TFP. Dollar and Wolff (1993) investigate this hypotheses for the US. The emphasis lies on a comparison with Japan, but on one occasion other countries are also taken into account. In Table 4 changes in US RCAs are set against changes in sectoral TFPs for eight countries relative to the US.⁴ It should be noted that changes in TFP cover the period 1965-1982, which implies that during this period catching-up is still under way. Moreover, compa-

Table 4. *Change in US RCAs and relative changes in TFPs.*

	US RCAs % changes 1970-82	Relative TFP (8 countries) % changes 1965-82
<i>Increasing comparative advantage</i>		
Textiles	48.5	21.4
Electrical goods	14.5	28.3
Nonmetallic minerals	8.7	16.5
Machinery	8.0	6.1
Other industries	6.0	-12.3
Mean (5 industries)	17.1	12.0
<i>Stable comparative advantage</i>		
Rubber and plastic	0.9	16.4
Paper and printing	-1.1	12.3
Mean (2 industries)	-0.1	14.4
<i>Decreasing comparative advantage</i>		
Chemicals	-3.0	40.0
Food, beverages, tobacco	-10.6	-5.4
Metal products	-15.8	34.7
Transport equipment	-17.3	-5.6
Basic metals	-33.6	20.0
Mean (5 industries)	-16.1	16.7

Source: Dollar and Wolff (1993).

⁴ The 8 countries are: Belgium, Canada, France, Germany, Italy, Japan, the Netherlands and the UK.

relative advantage is generated by relative cost differences. For all twelve industries in Table 4 the average change in TFP for the countries involved relative to the US amounts to 14.4%. Industries with increasing comparative advantage for the US show a mean change in relative TFP of 12.0%. In contrast, industries with decreasing comparative advantage for the US realize a relative rise in TFP of 16.7% on average. Two major anomalies in the latter category are transport equipment and food, beverages and tobacco. However, the food processing industry is subject to government intervention and the decline in the competitive position of the US may be due to importing countries. The anomalous result for the transport equipment sector has to do with aggregation problems. Japan realizes a strong export position in motor vehicles, whereas the US has a relatively good TFP and export performance in aircraft. All in all, there is some evidence for a relationship between the growth of industry TFP and changing comparative advantage for the US *vis a vis* the other industrialized countries. But further research along these lines is needed to get a more comprehensive picture.

If technologies are to a certain extent firm-specific patterns of international specialization may be reinforced. A larger market share may increase the opportunity for learning by doing or may rise the profitability of investment in R&D. Krugman (1987, p. 112) summarizes the argument in an illuminating way: "Like a river that digs its own bed deeper, a pattern of specialisation, once established, will induce relative changes that strengthen the forces preserving that pattern." From this perspective the international division of labour is path-dependent, so that past history as well as current government policy will have major effects on emerging export patterns. Dollar and Wolff (1993, p. 148) provide some evidence in noting: "US concentration of R&D on military-related industries clearly is a major explanation of US comparative advantage in aircraft, large-scale computers, and advanced telecommunications. Japanese industrial policy, on the other hand, has targeted R&D at advanced consumer products, such as automobiles and consumer electronics."

4.2 *The adoption of new technologies*

In many cases full appropriability of knowledge is not possible. If not, competitors benefit from knowledge spillovers and such externalities may induce underinvestment in R&D. However, on many occasions the introduction of new technologies requires adjustment on the part of the adopting firm. This holds *a fortiori* if the existing technology and the new one differ in a fundamental way. Some empirical evidence at the micro level showing that adoption costs are important is given in Jovanovic (1995).

Firms have to be convinced that investing in adoption cost is worthwhile. If it takes too much time to assess the potentialities of a new technology adoption may be prohibitive. In a world with imperfect information it may be difficult to choose the right moment and the window of opportunity may be closed before the decision to switch is made. The penalty for such a hesitant behaviour may be loss of market share or even a complete wiping out. The outstripping of German camera manufacturing by Japanese competitors in the period 1973-

1986 is clear example of overtaking based on a superior technology (Bolwijn and Kumpe, 1994, p. 19).

To illustrate the main aspect of the adoption strategy we construct a simple two-sector general equilibrium model. In the x -sector there are two firms with a different technology. Firm 1 produces according to the more traditional α -technology, whereas firm 2 applies the more advanced β -technology. Productivity rises in both firms as a result of learning by doing, but the β -technology has a higher learning potential than the α -technology. The y -sector is introduced because we analyse the technology choice in the x -sector in the context of a general equilibrium model. Technological change in this sector is exogenous and to simplify it is assumed that there is only one firm. Moreover, labour (l) is the only production factor in the economy and consumers have uniform preferences.

Denoting labour productivity by h_x production in the x -sector follows from

$$(1) \quad x_1 = h_{x1} l_{x1}$$

$$(2) \quad x_2 = h_{x2} l_{x2}$$

Subscripts 1 and 2 relate to firms. Labour productivity in the y -sector is denoted by h_y , so that

$$(3) \quad y = h_y l_y$$

Labour market equilibrium is given by

$$(4) \quad l_{x1} + l_{x2} + l_y = l$$

where l is the given amount of labour supply.

Consumers spend their labour income on goods from both sectors. The consumption ratios are determined by the demand equations

$$(5) \quad \frac{x_1}{x_2} = \left(\frac{p_{x1}}{p_{x2}} \right)^{-\varepsilon}$$

$$(6) \quad \frac{x_2}{y} = \left(\frac{p_{x2}}{p_y} \right)^{-\varepsilon}$$

The intersectoral elasticity of substitution ($\varepsilon > 1$) is set equal to the intrasectoral rate of substitution (ε) without loss of substance.

Firms maximize profits subject to a demand curve with a constant price elasticity (ε)

which follows from equations (5), (6) and the circular flow of money. All firms face the same given wage rate, w . Profit maximization then results in mark-up pricing according to

$$(7) \quad p_{x1} = \frac{\varepsilon}{\varepsilon - 1} \frac{w}{h_{x1}}$$

$$(8) \quad p_{x2} = \frac{\varepsilon}{\varepsilon - 1} \frac{w}{h_{x2}}$$

$$(9) \quad p_y = \frac{\varepsilon}{\varepsilon - 1} \frac{w}{h_y}$$

Choosing the y -good as numéraire ($p_y = 1$) the static system consisting of equations (1) - (9) can be solved for: $x_i, l_{xi}, p_{xi}, y, l_y$ and w ($i = 1, 2$).

Learning by doing in the x -sector raises labour productivity over time depending on the applied technology:

$$(10) \quad h_{x1}(t+1) - h_{x1}(t) = \alpha x_1(t)$$

$$(11) \quad h_{x2}(t+1) - h_{x2}(t) = \beta x_2(t)$$

The β -technology is superior to the α -technology so that $\beta > \alpha > 0$. But the initial productivity level of firm 2 is lower than that of firm 1: $h_{x2}(0) < h_{x1}(0)$. Technological change in the y -sector is exogenous:

$$(12) \quad h_y(t+1) - h_y(t) = \gamma h_y(t)$$

Firm 1 can switch to the β -technology by incurring adoption costs, a . It is assumed that these adoption costs rise progressively as firm 2 builds up experience by using the β -technology and firm 1 still delays adoption:

$$(13) \quad a(t) = \xi \left[\frac{h_{x2}(t)}{h_{x2}(0)} \right]^2$$

Therefore, as time passes it becomes harder for firm 1 to switch technologies.

The strategic decision to apply the β -technology instead of the α -technology is based on a subjective assessment of the profit potential of the competing technology. Denoting operating profits by π we have:

$$(14) \quad \pi_i = x_i p_{xi} - l_{xi} w - f$$

$$(15) \quad \pi_2 = x_2 p_{x2} - l_{x2} w - f$$

where f equals fixed cost of production. Firm 1 makes an estimate of the profits it can realize by switching to the β -technology ($\hat{\pi}_{1\beta}$) by averaging the realized profits of firm 2. The number of periods (n) over which the average is calculated is a key parameter in the strategy decision of firm 1. These ideas on backward looking expectations formation can be formalized by writing:

$$(16) \quad \hat{\pi}_{1\beta} = \frac{1}{n} \sum_{t=n}^t \pi_2(t)$$

The switching period $t = T$ is chosen such that the present value of the estimated gain in profits of switching technologies equals the cost of adoption. Denoting the given interest rate by r we get:

$$(17) \quad \hat{\pi}_{1\beta}(T) - \pi_1(T) = r a(T)$$

No switching occurs as long as the left hand side of equation (17) is smaller than the right hand side. Firm behaviour is myopic in the sense that operating profits used in the decision making process are treated as constant in the future. In reality profits change as competitive positions of firms shift. We assume that firm 1 cannot observe the learning process that is going on inside firm 2. The superiority of the β -technology is revealed by the rising profit level of firm 2. Imperfect information induces firm 1 to apply a short-cut in maximizing the value of the firm.

The key parameter in strategic decision making is n , the number of periods chosen to assess the profitability of the superior β -technology. If firm 1 waits too long its market share may go down to a level that makes losses inevitable. If the decision is made more promptly firm 1 shares the market with firm 2 after the switch of technology has been accomplished. These different aspects of strategic decision making can be illustrated by presenting numerical solutions of the model.

The numerical exercises presented below are based on the following parameter values: $\varepsilon = 3$, $\alpha = 0.01$, $\beta = 0.035$, $\gamma = 0.3$, $\xi = 7$, $f = 2$, $r = 0.1$, $l = 25$, $h_{x1}(0) = 2.8$, $h_{x2}(0) = 2$, $h_y = 2$. The y-good is chosen as the numéraire ($p_y = 1$). The time paths of the endogenous variables are calculated for two different values of the strategic parameter: $n = 2$ and $n = 3$. To save space we show the outcomes for the most critical variables by drawing graphs.

Insert *Figures 3a, 3b*

The results in case $n = 2$ are shown in Figures 3a and 3b. The window of opportunity is defined as the time period $T_1 T_2$. At T_1 profits of the initially backward firm 2 (π_2) are equal to profits of the initially leading firm 1 (π_1). At T_2 profits of firm 1 would be zero if that firm

sticks to the α -technology. The estimated profitability of the β -technology $\hat{\pi}_{1\beta}$ falls short of the realized profits by firm 2 because it takes time for firm 1 to assess what is going on. Nevertheless firm 1 switches to the β -technology before it is too late as appears from Figure 3a. The switching time T_s lies between the points ${}_1T$ and ${}_2T$. As shown in Figure 3b the change in technology is rewarding at the point where the estimated present value of the switch $\Delta \equiv$

$\frac{\hat{\pi}_{1\beta} - \pi_1}{r}$ equals the adoption cost a . The latter variable rises over time because it becomes more difficult for firm 1 to adopt the superior technology as its competitor accumulates experience and perfectionates this technology in the learning process. At the other hand, it becomes clear that the β -technology raises the opportunity for making profits at the expense of the α -technology. At $t = T_s$ the expected revenues of adoption are on the verge of surpassing the required costs, which induces firm 1 to switch. Thereafter both firms share the market of the x -sector in an even manner and profits are equal as shown in Figure 3a.

In case $n = 3$ it takes firm 1 too much time to assess the situation as illustrated in Figures 4a and 4b. The distance between the estimated profitability of the β -technology ($\hat{\pi}_{1\beta}$) and the profits realized by firm 2 (π_2) is much larger than in the former case. As a result, the window of opportunity is closed before firm 1 decides to adopt the β -technology and the market for x -goods is monopolized by firm 2. The estimated revenues of switching to the β -technology do not rise fast enough to match the increase in adoption costs as appears from Figure 4b. At $t = T_2$ it is closing time for firm 1. One may wonder why firm 1 does not change its way of assessing the situation if bankruptcy lies around the corner. In reality this may sometimes happen. But if some kind of shocking experience forces the firm to change policies it might be too late. It takes time to reorganize a complex system. A forced change may increase adoption costs dramatically. However, everything is possible. In a dynamic and uncertain world decision making is not a mechanical process and the odds can go either way. That is the message conveyed by our simple model of strategic behaviour. It is also a message that is borne out by numerous case studies of industrial development.

Insert Figures 4a, 4b.

5. Conclusions.

Postwar economic development in Europe has gone through different stages. Until 1973 catching up was the dominant feature. Firms could imitate US technology and accumulate capital rather easy as domestic savings were abundant. Entrepreneurial activities were focussed on efficiency improvement, mechanization and mass production. Effective demand was not felt as a constraint.

According to Maddison (1995) things changed dramatically after 1973 as effective demand became an important constraint under the impact of deflationary policies. Without

denying that the argument has some validity we have concentrated our analysis on the fundamental changes that took place on the supply side of the economy. First, the change to a lower long-run of growth required drastic structural adjustment. Traditional investment goods sector had to give room to final output sectors, which resulted in excess supply of primary capital. Second, as the European countries approached the technology frontier innovation became the driving force of competition. This required a fundamental reorientation on the part of European business. Own research and development aimed at innovation became more important, the organization had to be more flexible and the interplay with customers went into a new phase.

Increased international competition is one side of the coin. The other side is the possibilities for international specialization as countries succeed in building upon their own strength. What matters is the interactions between institutions and strategic behaviour. Alain Peyrefitte (1995, p. 425) is right in observing: “Le développement a été, est, sera un combat. Combat intérieur, en chacun d’entre nous, pour substituer l’énergie à la résignation, l’invention à la routine. Combat au sein de la société, pour que, dans ses institutions et dans ses acteurs, les forces de la confiance l’emportent, à chaque niveau, sur celles de la défiance.”⁵

⁵ “Development has been, is, will be a fight. A fight inside everyone of us to substitute energy for resignation, invention for routine. A fight at the center of society so that in its institutions and in its actors at every level the forces of trust dispel those of distrust.”

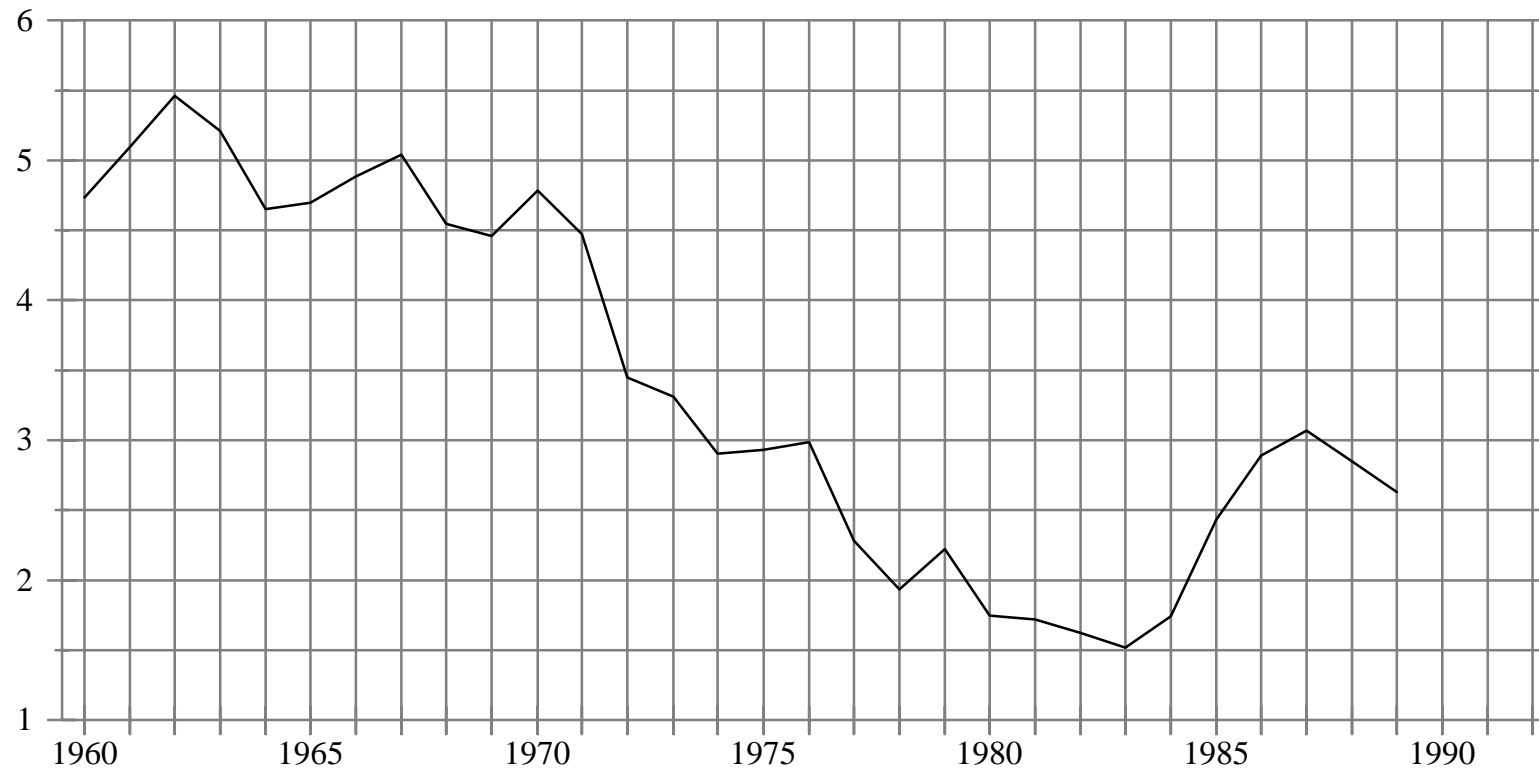
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EU-5 Growth

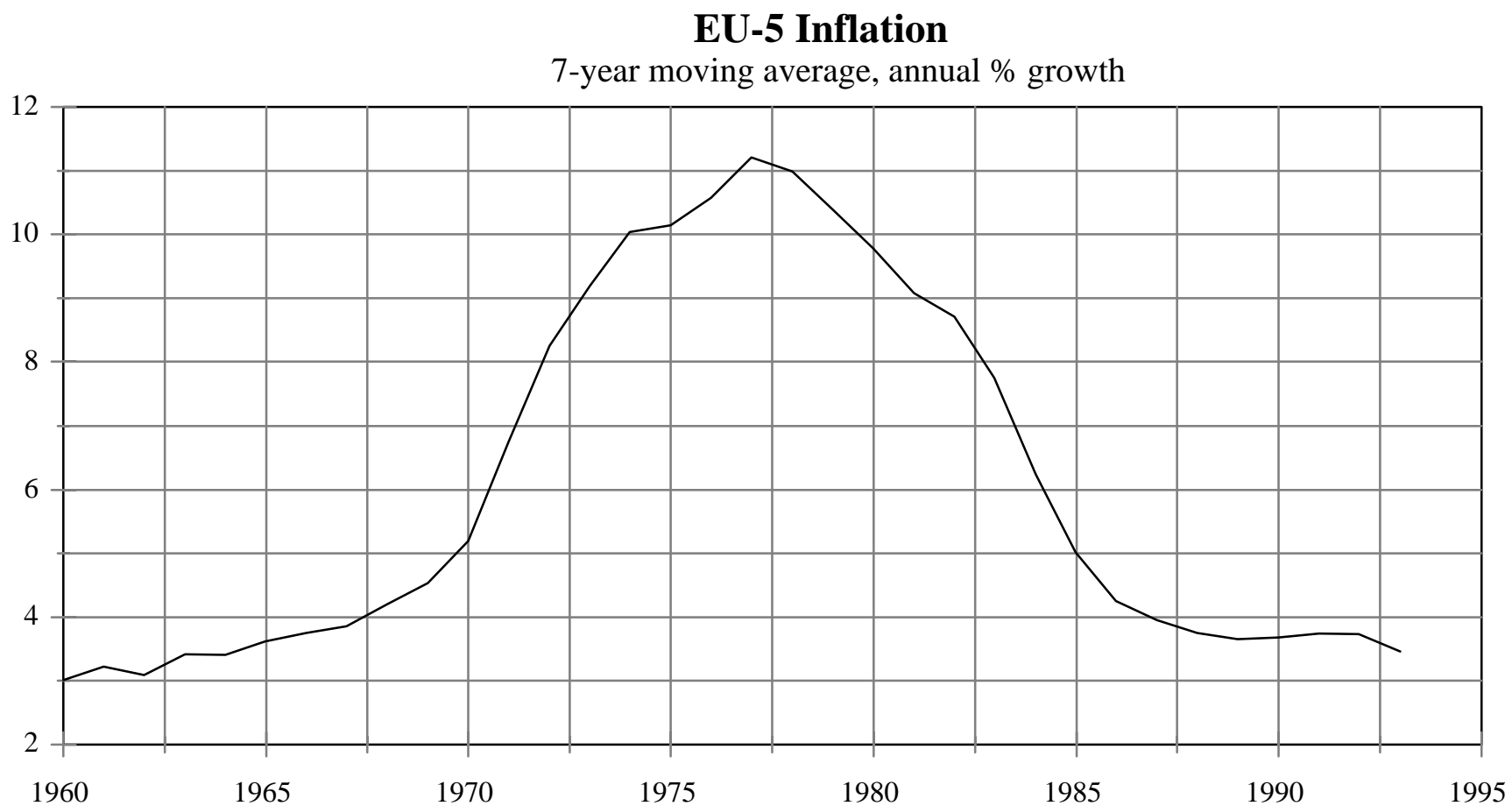
7-year moving average, annual % growth



Note: EU-5 contains France, West-Germany, Italy, The Netherlands, UK

Source: PWT 5.6

Figure 1



Note: EU-5 contains France, Germany (prior to 1990 West-Germany), Italy, The Netherlands, UK

Source: International Financial Statistics (IMF), Yearbooks of 1988, 1992, 1997

Figure 2

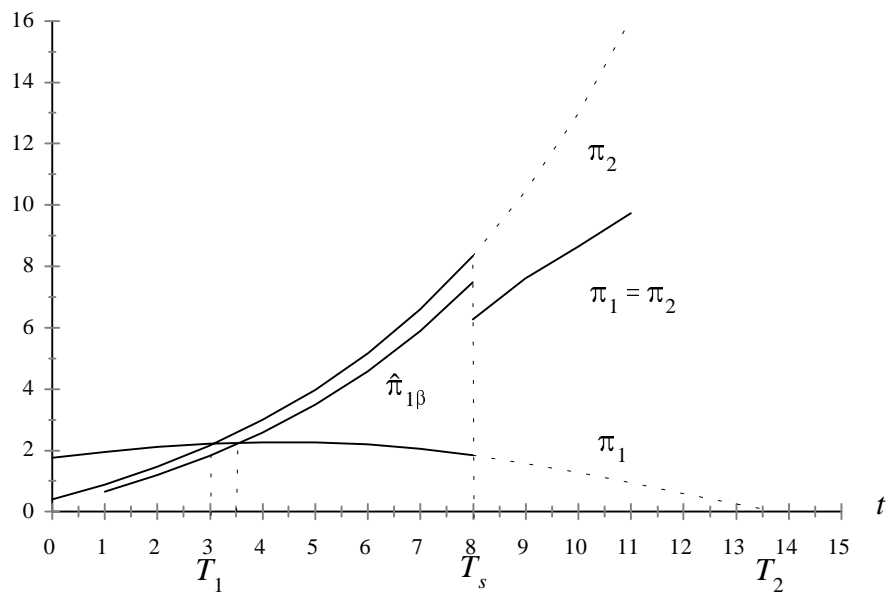


Figure 3a

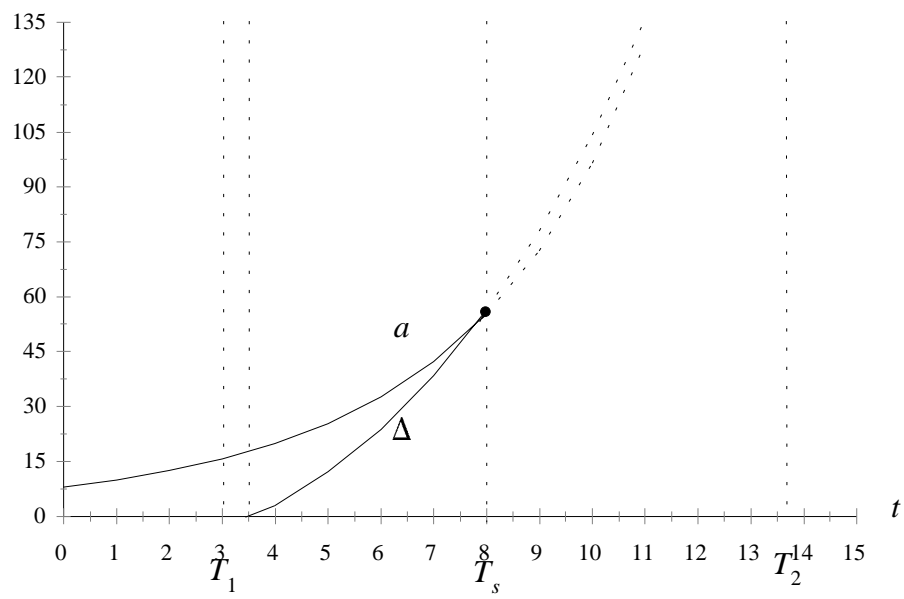


Figure 3b

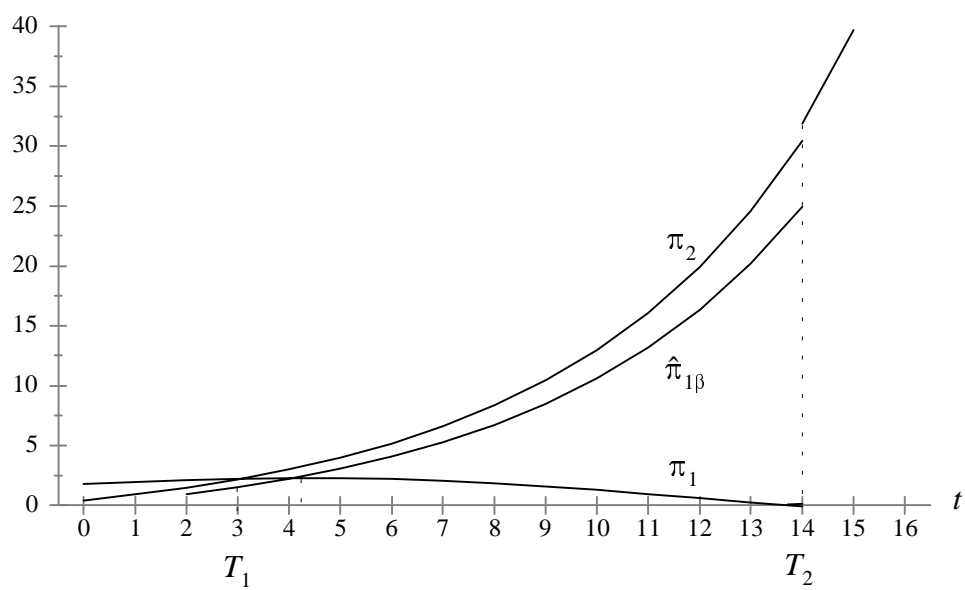


Figure 4a

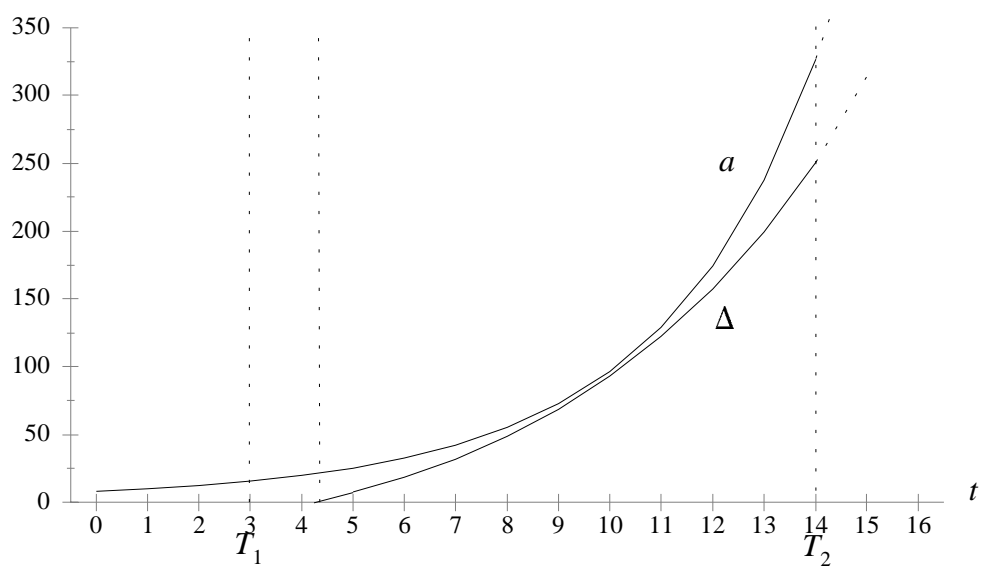


Figure 4b